

*Local conditions.*—The pressure at St. Louis, at 8 a. m. August 19, was 29.89 inches; there was a constant decline thereafter until about 9 p. m., when the lowest point was reached, 29.66 inches reduced pressure or 29.06 station pressure; the relative humidity was high during the greater portion of the day, 94 per cent at 8 a. m., 91 per cent at 1 p. m., dropping slowly to 79 per cent by 8 p. m. A thunderstorm appeared in the northwest portion of the city during the early afternoon, the first thunder being heard at 2:55 p. m. This storm moved in an easterly direction to the north of the station; it was very local in character, and was confined to the northern portion of St. Louis and Madison. The storm gradually became more threatening over north St. Louis, the cloud movement indicating a rather violent local disturbance in that locality, but at no time did the storm appear especially destructive at any great distance from its path of action. As its course was 2 miles north of the local Weather Bureau office, it was beyond the vision of the observer. At 3:55 p. m. the storm assumed the characteristics of a tornado, violent winds being first noticeable at about No. 3200 north of Market street and No. 2500 west of the river; it moved almost due east, the extreme width of the path being about seven blocks, from No. 3200 to No. 3900 north. It appears to have bounded at intervals, from the fact that its destruction was less marked at some points along its path than at others. The storm evidently reached its maximum strength from Broadway, No. 500 west, to Second street, where telephone and electric light poles were broken and thrown to the ground, and the Broadway street car service was suspended until the next day; the Granite Iron Rolling Mills, No. 3400 north, seemed to have suffered the most severely, the estimated damage being \$25,000; about four other business houses were damaged and twenty-five or thirty dwellings injured. The writer personally inspected the damaged district and noted that the damage usually consisted of unroofed buildings, broken poles, electric and telephone wires; at no point did the damage appear to be irreparable or absolute.

The storm, after leaving St. Louis at the river front, passed eastward to Madison and East Madison, where it continued its devastation. The total property loss in St. Louis, according to conservative estimates, does not exceed \$100,000, and perhaps about the same amount in Madison and East Madison.

Three fatalities were reported and twenty persons were injured.

A peculiarity of the storm was its extremely local character. While the storm was at its height at 3:55 p. m. in north St. Louis, the central and southern portions of the city experienced only moderate breezes, partly cloudy sky, and but slight changes in temperature. Very little rain occurred, except in the immediate path of the storm. The temperature at 3 p. m. at this station was 83°; 4 p. m., when the storm was at its height, 82°; 5 p. m., 84°; the maximum wind, which occurred at about 4 p. m., was only 24 miles per hour; the barograph trace shows a steady fall in pressure, reaching 29.13 inches when the storm was passing north of the station, with a very slight rise of only 0.03 of an inch shortly after 4 p. m., and falling thereafter to a minimum pressure of 29.06 inches at about 9 p. m. The instruments at the exposition showed even less variation than did the station instruments.

#### CLOUDBURST NEAR CITRUS, CAL.

By W. E. BONNETT, Assistant Observer, in charge, Independence, Cal.

On August 8 showers were forming over the mountain peaks at 9:30 a. m. (Pacific time), somewhat earlier in the day than seems usual here. They gradually increased in number and extent until about 11:30 a. m., when the entire sky was overcast and threatening. The first thunder was heard at this time. These conditions culminated in very severe thunderstorms in the ranges, both to the east and west of us.

The most excessive precipitation occurred over what is known locally as Mazuka Canyon, cut in the western slope of the Inyo Range. This opens to a gently sloping sage-brush plain, three miles from the station of Citrus. When the flood emerged from the Canyon it spread itself over the fan-shaped deposit there, and flowed with a front of nearly two miles and a depth of several feet toward the station at Citrus. The country over which the water came is wholly uninhabited and the only damage that was done occurred about the station. Here several hundred feet of the railroad track were washed away and for a greater distance it was covered over with débris. One and one-fourth miles of an irrigating ditch, belonging to the East Side Canal Company, was filled up.

#### THE ANNUAL AND GEOGRAPHICAL DISTRIBUTION OF CYCLONES OF HIGH VELOCITY (OVER 500 MILES IN TWELVE HOURS) IN THE UNITED STATES, 1893-1902.<sup>1</sup>

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*Summary.*—The object of the study, the preliminary results of which are herein summarized, was to determine the influence of areas of high pressure (highs), and especially of the so-called St. Lawrence high,<sup>2</sup> upon the velocity and direction of movements of areas of low pressure (lows). In preparation for this investigation, all cyclones of high velocity (over 500 miles in twelve hours) during the years 1893-1902 were considered. No relation between the velocities of cyclones and the barometric gradient could be made out in the case of cyclones in the western portion of the southern circuit.<sup>3</sup>

The reason for this fact was doubtless that of about 130 cyclones in ten years there were about 110 secondary lows, which were deflected to the south, and the laws of the movements of secondary lows, which are under the influence of primary lows, are extremely complex. The 20 primary cyclones remaining showed too little similarity for purposes of comparison. But it distinctly appeared that the relation of the velocity of cyclones to the gradient was such that higher velocities occurred with weaker gradients in front of the cyclones.<sup>4</sup>

The next point taken up was the geographical distribution of the occurrence and of the velocities of rapidly moving cyclones, and, as is shown in the tables and charts which follow, there is a distinct deflecting and splitting effect on the part of the St. Lawrence high in the case of the eastern portion of the southern circuit track of these cyclones. The lows which are deflected to the right of the high move more rapidly than those which are deflected to the left. The splitting in the northeast is most marked in February and March, and there is practically none in January. This is probably due to the nearly equal velocities of lows and highs in January and to the passage of the southern circuit lows to the left of the St. Lawrence high in November and to the right in December.

No definite answer has been obtained to the question set as the object of this study, but some preliminary results have at

<sup>1</sup> Preliminary report on work done during the year 1903-4 in the course Geology 26 (Climatology: advanced course), given under the direction of Prof. R. De C. Ward, in Harvard University.

The instructor's share in this work has been limited to some general suggestions at the beginning of the investigation, occasional conferences during its progress, and a revision of this report for publication.—ROBERT DE C. WARD.

<sup>2</sup> The term "St. Lawrence high" is attributed to any high which, on its path eastward, hangs persistently in the locality of the Gulf of St. Lawrence, checking the progress of lows from the west.

<sup>3</sup> "Northern circuit" is one main path of circulation of cyclones passing directly eastward (from the Northwest British Possessions) over the Great Lakes and the St. Lawrence Valley to Newfoundland.

"Southern circuit" is second main path of circulation of cyclones along the Rocky Mountain slope southeastward to Texas, thence eastward over the Gulf States to the Carolinas, and thence northeastward to the Banks of Newfoundland.

<sup>4</sup> See E. B. Garriott: Types of storms in January. Monthly Weather Review, January, 1895, p. 10.